TIGA - Tide Gauge Benchmark Monitoring Pilot Project

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Introduction

The TIGA Pilot Project was initiated in response to the demanding need for highly precise height coordinates and their changes with time at tide gauge benchmarks. TIGA was formally established during the 16th IGS Governing Board Meeting in Nice (April 2001).

For the first time it is not the intention of the IGS to provide results with a very low latency, but to have as many stations included as possible. The primary product of the service is time series of coordinates for analyzing vertical motions of Tide Gauges (TG) and Tide Gauge Benchmarks (TGBM). All products will be made public to support and encourage other applications, e.g. sea level studies. In particular, the products of the service will facilitate the distinction between absolute and relative sea level changes by accounting for the vertical uplift of the station, and are, therefore, an important contribution to climate change studies. The service may further contribute to the calibration of satellite altimeters and other oceanographic activities. The pilot project will operate for a period of three years, from 2001 to 2004. After this period the IGS Governing Board will evaluate the project and decide whether or not this activity should become a regular IGS service function.

The goals of the TIGA-PP are identified as follows:

1. Establish, maintain and expand a global Continuous GPS at Tide Gauges (CGPS@TG) network
    *   Select a set of GPS-equipped tide gauges with a long and reliable history practicable for both sea level change studies and satellite altimeter calibrations.
    *   Apply IGS network operation standards.
    *   Promote the establishment of more continuously operating GPS stations in particular in the southern hemisphere.
    *   Promote the establishment of links to other sites, which may contribute to vertical motion determination, e.g., VLBI, SLR, DORIS and/or absolute gravity stations.
    *   Develop recommendations for a minimum technical standard of the whole tide gauge system to be included into the Pilot Study, e.g., sensor types, the nature of the leveling program, and metadata documentation.

2. Contribute to the procedures in which IGS realizes a global reference frame in order to improve its utility for global vertical geodesy. This may involve reprocessing a significant subset of the (past and present) IGS global tracking data set.

3. Compute precise station coordinates and velocities for the CGPS@TG stations using a processing stream that runs months behind real-time in order to include the largest possible number of stations. This effort will incorporate all previously collected GPS data at each CGPS@TG station. Later on the combined solution will have a maximum latency of one year.

4. Establish a secondary processing stream with much reduced latency in order to support operational activities that cannot tolerate large processing delays.

5. Monitor the stability of the network.

The progress of the project and other related information is maintained at the WEB site http://op.gfz-potsdam.de/tiga/. The full Call for Participation can be found at http://op.gfz-potsdam.de/tiga/DOWNLOAD/TIGA_CfP.pdf.

Major Steps

An initial meeting was held during the APSG Sea Level Workshop in Hawaii (April 2001). A wide range of experts attended this meeting from the tide gauge as well the GPS community. A very intensive discussion took place aiming at the goals and deliverables of TIGA. Participants agreed on two main points. The first is that the completeness of data has a much higher priority than the latency of the processing stream. A second, only CGPS@TG's will be considered in a final solution for which all information, including the leveling data, is freely available to the scientific community.

Consequently, a Call for Participation was drafted and issued in June 2001. In total 23 Letter of Intent arrived, while finally 15 proposals were submitted. Proposals are covering all components of TIGA. These components are in particular TIGA Observing Stations (TOS), TIGA Data Center (TDC, 6 proposals), TIGA Analysis Centers (TAC, 8 proposals), and TIGA Associate Analysis Centers (TAAC, 2 proposals).

By the end of 2001 the review of the proposals was completed and a Letter of Acceptance was sent out.

TIGA Components

TIGA Observing stations are primarily, but not exclusively, existing IGS and EUREF stations. Some agencies are providing now also their GPS data not previously part of the IGS. Due to the higher latency of the processing also data from remote stations can be included into the routine analysis. A site information log for TOS was developed displaying necessary additionally information for each tide gauge. This log sheet supplements the standard IGS log. A plot of current TIGA Observing Stations is given in the figure attached. TOS forms are available at the TIGA web page.

TIGA Analysis Centers will process data in different chains. The primary chain will have a latency of 460 days, which allows also the very remote stations, e.g. from Antarctica, to provide their data. A secondary chain will provide solutions with a very short latency to support operational aspects. In addition a few processing centers have agreed to re-compute a selected subset of the IGS and other network data (including a retro-processing of IGS station data for CGPS@TG) for an improved long-term stability of the reference frame since the inception of the IGS.

TIGA Associate Analysis Centers will facilitate TIGA in two different ways. This ranges from the processing of a selected regional subset of CGPS@TG stations, while others will

techniques or absolute gravity measurements.

As a new component, <u>TIGA Data Center</u> will not only store and re-distribute GPS data, but also metadata. They will fulfill three functions:
1. Store GPS data sent by different media (FTP, computer tapes, CD-ROM, diskettes, etc.) with high and changing latency.
2. Store Metadata (e.g. leveling data, sketch maps of the TG) of any kind (e.g. computerized, handwritten, microfiches, etc.)
3. Establish links to Tide Gauge Data Centers for easy and convenient data access.

Future Tasks

By 2002 a regular service will be established for the continuous processing of CGPS@TG data. Starting with a high latency processing chain, the reprocessing of older data will be initiated too.
Also by 2002 more TOS stations will become available to complement the existing network. A main and important task will be also the constant effort for the establishment of more leveling ties to tide gauge benchmarks.
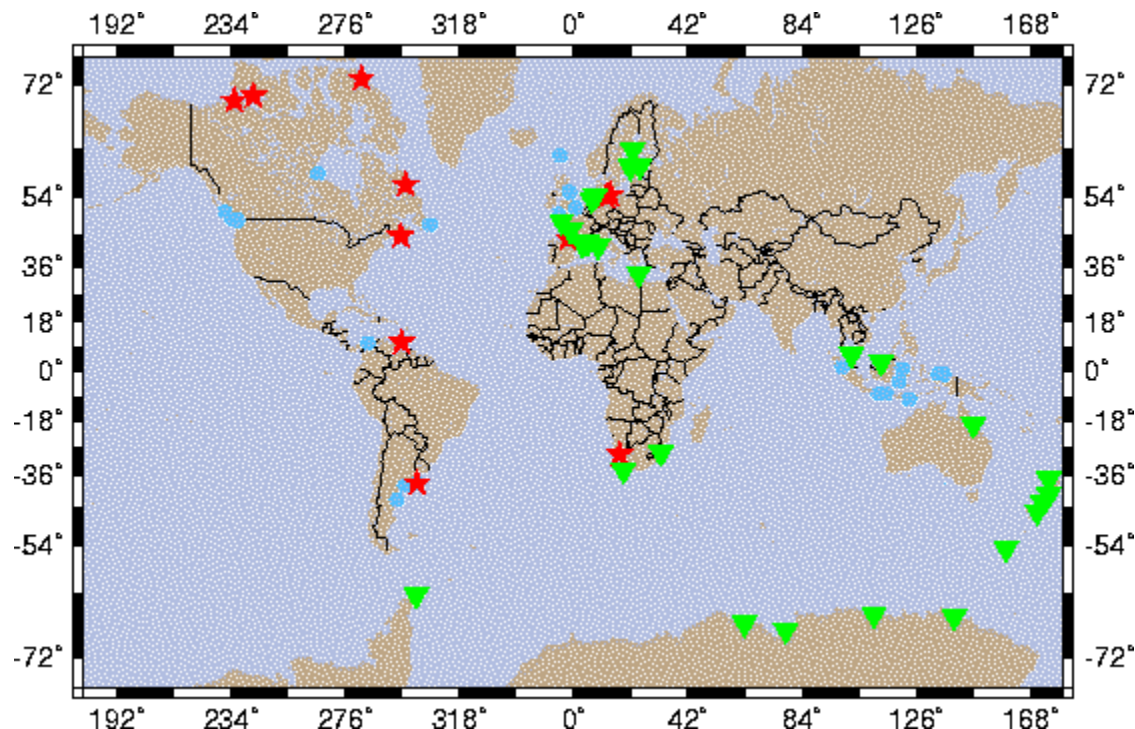
Overview about the current status of TOS stations (as of August 2002)
For few stations (triangles) all necessary information is available. In the near future, more stations will become available (dots). In response to the TIGA Call for Participation also new GPS stations will be installed near tide gauges (stars).